Table 4 Satisfaction with the Internet Independent Samples Tests			
	t-test for Equality of Means		
Equal variances Assumed			Sig.
	t	df	(2-tailed)
Satisfaction with E-mail	-1.95	247	0.05
with World Wide Web	-3.08	208	0.00
with Usenet	0.45	97	0.66
with IRC/MUD	-0.99	52	0.33
with FTP	-2.41	152	0.02
..as a way to communicate in genera	-2.18	254	0.03
..as a way to socialize	2.15	254	0.03
..as a way to be entertained	-0.71	254	0.48
..as a way to learn new things	-3.65	254	0.00
..as a way to be more efficient	-4.23	254	0.00
..as a way to get information	-3.53	254	0.00
..as a way to shop	-2.48	254	0.01
..as a way to work fromhome	-4.71	254	0.00
Satisfaction with on-line speed	-6.79	254	0.00
..with reliability	-1.51	254	0.13
..with cost of service	4.82	254	0.00
..with customer service	-3.19	253	0.00

Table 5 displays the results of chi square analysis of whether the use of a "part" of the Internet is related to modem speed. The procedure compares the expected frequency of adoption of a "part" of the Internet (Email, Web, Usenet, FTP, IRC/MUD, Internet telephony/videoconferencing) to the observed frequency by modem speed. Cable modem subscribers are more likely to use FTP, the Web, Usenet and Internet tel/vid. The differences are statistically significant as well. There are no distinguishable differences between cable modem subs and slower speed Internet access for email and IRC/MUD use.

The results of the means tests mentioned earlier do not indicate that users of synchronous IRC/MUD communications are more satisfied. In terms of consumption, cable modem users are neither more likely to use IRCs and MUDs according to chi square analysis. However, they are statistically and significantly more likely to use Internet telephony or videoconferencing.

Means tests indicate that users of asynchronous, data-intensive "parts" of the Internet (FTP and Web) are significantly more satisfied than dial-up access users. Likewise, cable modem subs are more likely to have adopted and use FTP and the Web, according to crosstabs and significant chi square statistics.

Table 5
Results of Chi Square Analysis
Expected versus Actual Adoption
by Modem Speed

	Cable Modem	Dial-up Modem	Significance
Uses Email	117	130	0.57
Uses Web	119	90	0.00
Uses Usenet	74	23	0.00
Uses FTP	99	53	0.00
Uses IRC/MUD	27	27	0.38
Uses Inet Tele/Vid Conf.	21	12	0.03

While Internet use can be categorized by the strict applications given above (email, Usenet, videoconferencing, and so on), it can also be measured in terms of how users turn to the Internet to satisfy needs and accomplish tasks. Table 6 shows how people reported their use in this way. Survey respondents were asked how frequently they used the Internet to accomplish 28 different tasks — everything from "meeting new people," "passing the time," "getting news," and "downloading video clips" to "shopping," "selling products or services," "to save time," and "work-related research." These 28 needs and tasks were later converted to six statistically reliable scales called "Sociability/Strangers," "Sociability/Friends/Family," "Diversion," "Acquisition of Information," "Acquisition of Goods," "Work/Time Management," "Work/Internet Business."

If limited by norms for statistical reliability, cable modem adopters used the Internet more frequently and intensely for acquisition of both goods and information, and work-related tasks and needs. According to the survey results, cable modem users also used the Internet more for diversion (entertainment) and socializing but the differences are small and not statistically significant. In any case, one can safely conclude that faster Internet access is associated with greater reliance on the Internet.

Consumption was measured in other more conventional ways as well. Both in terms of time spent on-line and money spent on Internet access, cable modem subscribers spent more. On average, 2.22 hours the previous day, versus three quarters of an hour for the slower access group. ($t=-5.712$, $p<.001$). This is a highly meaningful difference! However, we cannot tell whether the cable modem *causes* people to spend more time on-line, we just know the two are related. Since the research suggests people perceive the Internet to be much more efficient with a cable modem, one might suppose that faster download times would lead to spending *less* time on-line. The focus group and survey results imply, however, that once the Internet becomes more interactive and responsive, it is more useful for more tasks thus leading to more time on-line.

Not surprisingly, high speed access users spent substantially more per month for Internet access as well[33]: 4.55 versus 1.65 for the slower access users ($t=-24.84$, $p<.001$)[34]. The average cable modem subscriber had a slightly higher monthly telephone expense as well.

Nielsen (1997), Simmons (1997) and other research organizations have been reporting for some time now that Internet adoption is related to reduced time spent with television. This study takes that trend one step further. Cable modem adopters spent on average 90 minutes with television the previous day while their dial-up modem counterparts spent 140 minutes ($t=2.36$, $p<.05$). Oddly, however, there seems to be a slight tendency among cable modem users to spend more time playing video games, reading more newspapers and magazines, ordering more PPV and renting more videos, but spending less time on the phone — than the slow modem comparison group. The cable modem group seems to use more and a greater variety of media, except for TV and telephone.

Table 6

Frequency of Using Internet for Various Task Categories

Sample Means and t-tests

Task Category	Cable Modem	N	Mean	Std Deviation	Significance of t-test
Acquisition of Info Uses	no	135	6.2	1.65	0.00
	yes	121	7.5	1.35	
Acquisition of Things Uses	no	135	8.1	2.41	0.00
	yes	121	11.5	2.97	
Diversion Uses	no	135	10.8	3.16	0.17
	yes	121	11.4	3.27	
Marketing/Work Uses	no	135	3.6	1.01	0.00
	yes	121	4.7	1.72	
Sociability/Friends&Family	no	135	4.2	1.19	0.26
	yes	121	4.4	1.06	
Sociability/Strangers	no	135	2.9	1.13	0.85
	yes	121	3	1.1	
Time Management/Work Uses	no	134	13.9	3.86	0.00
	yes	121	16.6	3.7	

[33] Readers should remember that the survey was conducted about one month before AOL's unlimited access policy was implemented. Several dial-up access users reported monthly Internet use expenses of over $100.

[34] Based on response categories in survey; 4.55 corresponds to roughly $45 to $60; 1.65 to between $0 and $20. About half of the dial-up access sample had free home access from a local university.

In summary, both satisfaction and levels of Internet and media consumption are strongly related to modem speed. Cable modem use is related to higher levels of satisfaction. Cable modem users spend a great deal more time on-line, using more "parts" of the network, and to accomplish a greater variety of tasks, many previously accomplished through other, non-electronic means. Finally, they seem to consume more and a greater variety of media -- except for TV and telephone.

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Appendix C A Model of the Economics of xDSL Supply

This appendix describes the structure and operation of a model that links prospective demand and cost conditions for DSL and calculates the profitability of a LEC's offering of DSL services.

a. Introduction

We designed this model to facilitate comparison of regulatory alternatives. The model requires specification of five primary inputs:

- Demand model parameters,
- Market (number of potential subscribers) and competitive conditions,
- Prices offered by the LEC and by the competitors,
- Prices for the building blocks of DSL service, and
- Rules for capital recovery and for calculating the costs of capital.

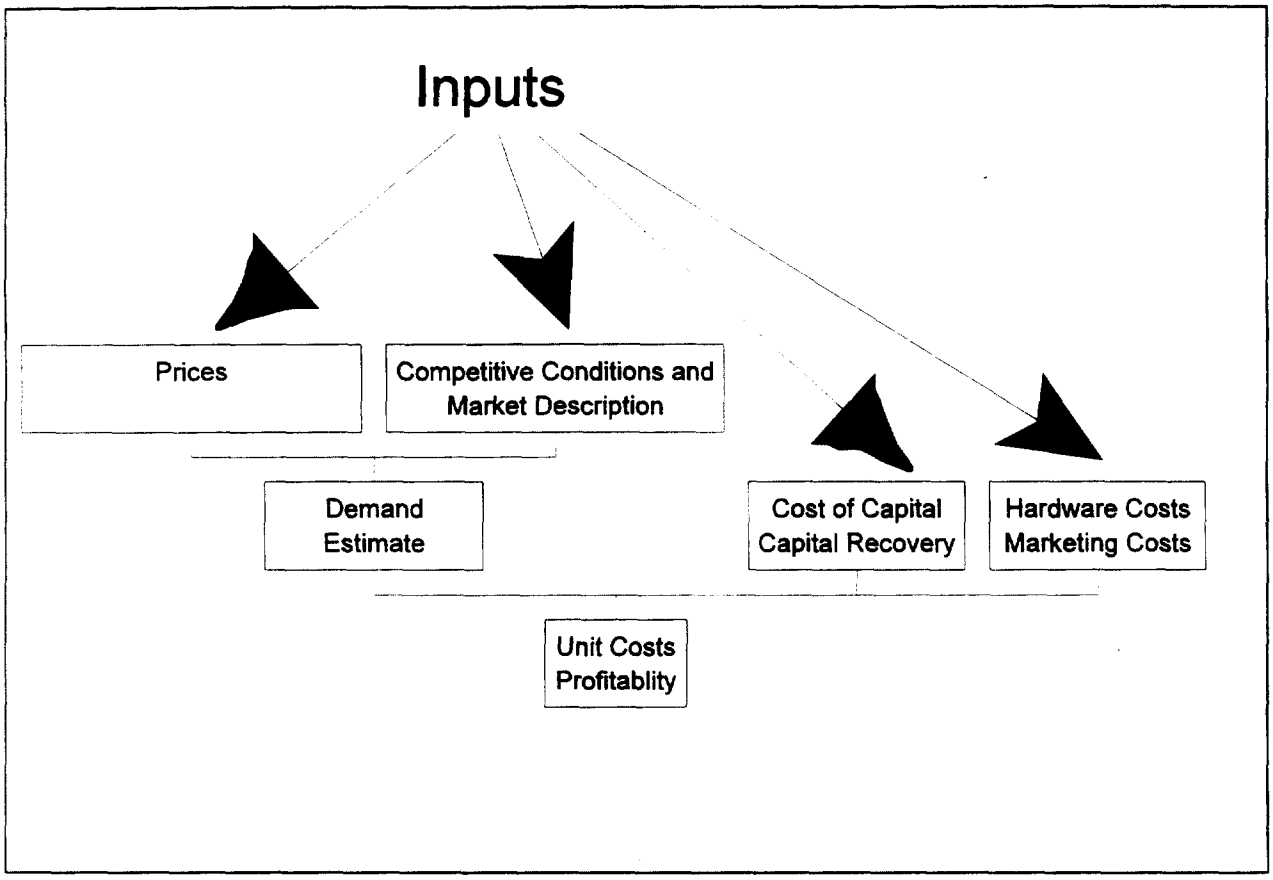


Figure Appendix C-1 Data flows in the cost model

Figure 1 below shows the data flow in this model.The model provides estimates of the market share, costs, and profitability of DSL service as a function of the provided inputs for each of the ten years from 1998 to 2007.

The model considers the provision of DSL service in a region. The region is divided into three subregions – urban, suburban, and rural – and prices, costs and competitive performance can be calculated separately in each subregion. The subregions are described by the number of potential subscribers in each subregion and the number of central offices. The model also supports variations in the cost of outside plant for each subregion. To assist in policy analysis, we designed the model to allow for the easy comparison of alternate capital recovery schedules for different classes of equipment and for the comparison of the economics of the firm using alternative values for the cost of capital.

The demand model takes as a model input primary demand for DSL services in each region. That demand is divided among the suppliers in the region as a function of the prices (or more accurately price differences) charged by the firms providing service in each subregion. The demand model incorporates an element of subscriber inertia – the user can specify how likely an existing subscriber is to leave their existing supplier and shop around. The model does not require that consumers choose the service from the firm with the lowest price. Rather, the greater the disparity in prices, the more likely the consumer is to choose the lower priced alternative.

The model is implemented as an Excel spreadsheet and should be used in an interactive and iterative manner. Below we consider the elements of the model in greater detail. We describe individual elements of the model. Because these elements interact, it is necessary to use some of the concepts before they have been fully explained. For example, the investment required is a function of demand, but demand may be determined in an iterative manner from price.

We used Microsoft Excel 97 to implement and debug the model. The model is composed of fourteen separate sheets combined in a single Excel workbook. The names of the sheets and the function of each sheet is shown in Table C-1 below.

Table C-1

Sheet Name	Function
Cover	Cover with model title and copyright notice
Scenario Inputs	This sheet contains the input data that are most likely to change from run to run.
Primary Demand Forecast	This sheet contains the calculation of the price vectors for both the firm under study and its competitors. These prices are then used to generate the forecast of primary demand (how many consumers will purchase high-speed Net access services if given the chance).

Sheet Name	Function
Expanded Inputs	More detailed price and subscriber data than is contained on the Scenario Inputs sheet. Users may wish to vary the price and subscriber data on this sheet if the patterns provided on the Scenario Inputs sheet do not permit the desired time pattern. Data describing the capabilities of the wire centers serving the region under study. Such capabilities include the plan for deploying xDSL service in wire centers and the fraction of subscribers in each wire center that can be reached by xDSL services.
Firm Cash Flow	For each year the firm's revenues, expenses, investment, net plant (a function of depreciation policy), cash flow, NPV of cash flow, and NPV of cash flows up to that year. The NPV of the entire project is also calculated.
xDSL Subscriber Economics	The economic results for each year on a per subscriber basis in table form.
Subscriber Economics Graphs	In graphic form the economic results for each year on a per-subscriber basis.
Regulatory Factors	The regulatory depreciation rates for various categories of investment. Note that the allowed cost of capital (also a regulatory factor) is entered in on Expanded Inputs sheet.
Administrative Support Costs	The administrative, sales, and support expenses associated with new customers, continuing customers, beginning xDSL service in a region, and beginning xDSL service at a specific central office.
Capital Cost Factors	The capital cost inputs. For each capital cost category the user can enter in the capital cost (for each year), any associated operating costs, and the economic depreciation rate for such investments. The capital cost categories include modems, inside wiring, outside plant, central office equipment, digital backhaul facilities, and OAM systems.

Sheet Name	Function
Revenues and Expenditures	The investment and expenses for each category of activity for each year
Incremental Cost Analysis	Used by the IncAnal macro to calculate the incremental expense associated with adding a subscriber in each year
Complementary Expenditures	Ccalculation of the consumer's expenditures on complementary goods and services. These include modems and inside wiring. The user must ensure that the costs used are consistent, that is, that the cost of inside wiring is assigned to the firm or the consumer – but not to both.
Market Share Calculation	Calculation of the number of subscribers the firm under study obtains each year in each subregion. The firm's market share is a function of its price compared with the competitor's price and the number of subscribers the firm had the year before.

b. Structure of the Model

In this section, we describe the structure of the model in detail. This description will enable a user to modify all data used in the model to calculate results and will allow one to understand the logic behind the model. Our description proceeds from front to back – describing the contents and logic of each sheet before moving on to the next. We begin with an overview of the model.

i. Overview

The model consists of three fundamental submodels – the primary demand model, the competitive market share model, and the firm cost model. The primary demand model calculates the number of consumers who are willing to purchase xDSL services or comparable competitive alternatives. The inputs to the demand model are the total number of consumers in the area under analysis in each of the years 1998 to 2007 and the prices charged in the area under analysis by the firm and

its competitors. The demand model uses a logistic curve adoption model to generate the demand function for each year. The S-shaped logistic curve is often used in such adoption studies.

The competitive market share model calculates the number of subscribers the firm obtains each year. Finally, given the number of subscribers, the model calculates the firm costs and cash flows. If the user executes the IncAnal macro, then the model will also calculate incremental costs.

c. Scenario Inputs

The Scenario Inputs sheet contains the data items most likely to be changed. Figure Attachment C-2 is an image of the top part of that sheet. The regions in which the user can enter data are shaded. The first data item the user can enter is a description of the run. Three character strings can be entered. The second item is the firm's hurdle rate or discount rate. This interest rate is used in calculating net present values for the enterprise. All calculations are done on a pre-tax basis.

Prices can also be entered in on this sheet in a shorthand fashion. The user enters in the 1998 prices and the rate of price decline. The model then calculates the price vectors.

	A	B	C	D	E	F	G
1	**Scenario Inputs**						
2							
3	**Run Description**						
4							
5							
6							
7	**Firm's hurdle rate**						
8	**Prices**						
9	**Firm under study**				**Rural**	**Suburban**	**Urban**
10	Annual Usage Charge in First Year				$525	$500	$425
11	Rate of Decline in Annual Charges				10%	10%	10%
12							
13	Installation Charge in First Year				$200	$200	$200
14	Rate of Decline in Installation Charge				10%	10%	10%
15							
16	**Competitor**				**Rural**	**Suburban**	**Urban**
17	Annual Usage Charge in First Year				$525	$500	$425
18	Rate of Decline in Annual Charges				10%	10%	10%
19							
20	Installation Charge in First Year				$200	$200	$200
21	Rate of Decline in Installation Charge				10%	10%	10%
22							

Figure C-2

The user also needs to supply the number of subscribers in the region under analysis. Entered in are the number of subscribers in each of the three subregions for the year 1998 and the annual growth rates as shown in Figure C-3.

Potential Subscribers by Subregion				
Year	Rural	Suburban	Urban	Total
1998	[redacted]			5,000,000
Annual Growth Rate	[redacted]			Average Growth Rate for 3% Region

Figure C-3

Figure C-4 contains the last section of the Scenario Inputs sheet showing how the user can enter in the number of central offices in each of the three regions and can also specify the fraction of such offices that the firm will make xDSL-ready in each year. This is done by specifying the fraction of offices that are xDSL capable in the first year (1998) and in the last year (2007). (On Figure 4 and subsequent figures, we have not displayed the shading indicating cells in which the user can input data. The spreadsheet itself does have shading to indicate cells that can be modified by the user.)

	A	B	C	D	E	F	G	H	I
33		Central Office Profile for Firm Under Study							
34									
35									
36	Number of central offices in each			Rural	Suburban	Urban			
37	subregion			100	100	50	Note: The model assumes linear growth in the fraction of		
38	Fraction DSL capable in first year			10%	10%	100%	DSL capable central offices over		
39	Fraction DSL capable in last year			50%	100%	100%	the study period		
40									
41									

Figure C-4

d. Primary Demand Forecast

The Primary Demand Forecast sheet contains the forecast of the fraction of subscribers who will be willing to subscribe to DSL services in each year in each subregion (see Figure C-5). Although these numbers are calculated by the model from the price vectors, they are in

unprotected cells and can be modified by the user. Thus, the user can easily modify the demand assumptions without being forced to use our demand model. However, if a user does modify these values, the user will break the connection to the formulas that automatically recalculate primary demand as prices are varied. Consequently, the user should not save the modified spreadsheet back under the same file name as was used earlier.

Forecast of Primary Demand

This model calcuates the fraction of all subscribers who would, if given the opportunity, subscribe to DSL service
The model uses an index based upon the prices charged by the firm under study and its competitors...

The table below is calculated from the prices and the demand model. Editing that table will change the demand used in other calculations in the total model.

	Fraction of consumers who will subscriber to DSL			Lowest Real Price			
Year	Rural	Suburban	Urban	Rural	Suburban	Urban	Logistic curve factor
1998	2.3%	3.0%	3.3%	$58	$47	$41	0.5614623
1999	3.8%	4.5%	4.9%	$50	$41	$36	0.7621413
2000	5.6%	6.3%	6.8%	$44	$36	$31	0.9900445
2001	7.7%	8.4%	9.0%	$38	$32	$27	1.2346932
2002	9.9%	10.7%	11.3%	$33	$28	$24	1.4841175
2003	12.3%	13.1%	13.6%	$29	$24	$21	1.7269688
2004	14.6%	15.4%	15.9%	$25	$21	$19	1.9541106
2005	16.9%	17.5%	18.1%	$22	$19	$16	2.1593852
2006	18.9%	19.5%	20.1%	$19	$16	$14	2.3396186
2007	20.8%	21.3%	21.8%	$17	$14	$13	2.494126

Figure C-5

The projected demand is based on the cost to consumers of taking DSL services. In our demand model those costs are expressed in monthly terms as 1/12 of the annual charges plus 1/12 of 25% of the sum of the installation charge and the costs of inside wiring upgrades and CPE. This latter term converts fixed costs associated with the consumer's use of DSL service to monthly costs for purposes of comparison. The minimum of these costs for the firm under study and its competition are calculated, and demand is then calculated from this minimum value. These prices are also indexed by an inflation adjustment. The section of the sheet in Figure C-6 contains the calculation of the comparison prices for both the firm under study and its competitors.

Firm Under Study								
		Combined Install and Usage Fees				Real Price		
Year	CPE	Rural	Suburban	Urban	Price Index	Rural	Suburban	Urban
1998	$500	$48	$46	$40	1.00	$58	$56	$50
1999	$415	$43	$42	$36	0.98	$50	$49	$44
2000	$346	$39	$38	$33	0.95	$44	$43	$38
2001	$291	$35	$34	$30	0.93	$38	$38	$33
2002	$245	$31	$31	$27	0.90	$33	$33	$29
2003	$208	$28	$28	$25	0.88	$29	$29	$25
2004	$178	$25	$26	$22	0.86	$25	$25	$22
2005	$154	$23	$24	$20	0.84	$22	$22	$20
2006	$133	$21	$21	$18	0.82	$19	$20	$17
2007	$117	$19	$19	$17	0.80	$17	$17	$15
Competitors								
		Combined Install and Usage Fees				Real Price		
Year	CPE	Rural	Suburban	Urban	Price Index	Rural	Suburban	Urban
1998	$500	$48	$46	$40	1.00	$58	$47	$41
1999	$415	$43	$41	$36	0.98	$50	$41	$36
2000	$346	$39	$37	$32	0.95	$44	$36	$31
2001	$291	$35	$33	$29	0.93	$38	$32	$27
2002	$245	$31	$30	$26	0.90	$33	$28	$24
2003	$208	$28	$27	$23	0.88	$29	$24	$21
2004	$178	$25	$24	$21	0.86	$25	$21	$19
2005	$154	$23	$22	$19	0.84	$22	$19	$16
2006	$133	$21	$20	$17	0.82	$19	$16	$14
2007	$117	$19	$18	$15	0.80	$17	$14	$13

Figure C-6

e. Expanded Inputs

This sheet contains several sets of data that are needed for the model and that are calculated from the data entered on the Scenario Inputs sheet. For example, the number of total subscribers in each subregion is described on the Scenario Inputs sheet by the number of subscribers in the first year and the rate of growth. On the Expanded Inputs sheet, this compressed description (six

numbers) is expanded to a specific number for each subregion for each of the ten years (thirty numbers). This section of the Expanded Inputs sheet is shown in Figure C-7. The user can edit these subscriber numbers. Thus, the exponential growth model (which permits simple inputs) can be replaced with any arbitrary choice of total subscribers for each year. As before, the user should recognize that editing these numbers will break the connection to the input data on the Scenario Inputs sheet. Consequently, the modified workbook should be saved under a new name.

Expanded Inputs

Demand and price quantities derived from the information on the scenario inputs page
Some less frequently changed quantities are entered on this page.

The information directly below is calculated on the Primary Demand Forec

	Primary Demand: Total subscribers in region				Primary Demand: Fraction of subscribers who would use one of the digital access alternatives			
year	Rural	Suburban	Urban	Total	Rural	Suburban	Urban	Total
1998	500,000	2,000,000	2,500,000	5,000,000	2.3%	2.5%	2.8%	2.6%
1999	500,000	2,080,000	2,550,000	5,130,000	3.8%	3.9%	4.3%	4.1%
2000	500,000	2,163,200	2,601,000	5,264,200	5.6%	5.7%	6.2%	5.9%
2001	500,000	2,249,728	2,653,020	5,402,748	7.7%	7.8%	8.4%	8.1%
2002	500,000	2,339,717	2,706,080	5,545,798	9.9%	10.1%	10.7%	10.4%
2003	500,000	2,433,306	2,760,202	5,693,508	12.3%	12.5%	13.1%	12.7%
2004	500,000	2,530,638	2,815,406	5,846,044	14.6%	14.8%	15.4%	15.1%
2005	500,000	2,631,864	2,871,714	6,003,578	16.9%	17.0%	17.6%	17.3%
2006	500,000	2,737,138	2,929,148	6,166,287	18.9%	19.1%	19.6%	19.3%
2007	500,000	2,846,624	2,987,731	6,334,355	20.8%	20.9%	21.4%	21.1%

Figure C-7

The Expanded Inputs sheet also contains some data that are less likely to change from run to run. One such data item is the fraction of subscribers in each region who can be reached by DSL technology. In the example in Figure C-8, we have assumed that loop length, use of subscriber carrier, and other technological constraints permit only 50% of rural subscribers to be reached by DSL but a full 80% can be reached in urban areas. These numbers are used later in estimating the number of consumers who can be served by the firm – in essence, they define limits on the potential market.[35]

---

[35] We would note that the fraction of subscribers that can be reached by DSL without substantial expenditures by the LEC for conditioning loops are still uncertain and depend upon the specific DSL technology being considered. The model permits the user to study the implications of various fractions of subscribers that can be served without loop conditioning.

year	Fraction of Subscribers who can be reached by DSL technology		
	Rural	Suburban	Urban
1998	50%	70%	80%
1999	50%	70%	80%
2000	50%	70%	80%
2001	50%	70%	80%
2002	50%	70%	80%
2003	50%	70%	80%
2004	50%	70%	80%
2005	50%	70%	80%
2006	50%	70%	80%
2007	50%	70%	80%

The table to the left represents the average loop performance. This table reflects loop length, bridge taps, etc.

Figure C-8

The Expanded Inputs sheet also contains expanded information on the characteristics of central offices in each subregion. The Scenario Inputs sheet contains a compressed representation of the number of central offices that are DSL capable in each year. That representation is expanded, as shown in Figure C-9, and can be edited – thus permitting any desired time pattern to be studied. As before, editing this sheet breaks the connection to the Scenario Inputs sheet and the workbook should be saved under a new name.

Wire Center Information

Central Offices or Remote Units

year	Number of central offices that will be DSL capable: Rural	Suburban	Urban	Total	Percent of central offices that will be DSL capable: Rural	Suburban	Urban
1998	10	10	50	70	10%	10%	100%
1999	14	20	50	84	14%	20%	100%
2000	18	30	50	98	18%	30%	100%
2001	22	40	50	112	22%	40%	100%
2002	26	50	50	126	26%	50%	100%
2003	30	60	50	140	30%	60%	100%
2004	34	70	50	154	34%	70%	100%
2005	38	80	50	168	38%	80%	100%
2006	42	90	50	182	42%	90%	100%
2007	50	100	50	200	50%	100%	100%

year	Average Subscribers per Office: Rural	Suburban	Urban	Overall	Subscribers served by DSL capable offices: Rural	Suburban	Urban
1998	5,000	20,000	50,000	20,000	50,000	200,000	2,500,000
1999	5,000	20,800	51,000	20,520	70,000	416,000	2,550,000
2000	5,000	21,632	52,020	21,057	90,000	648,960	2,601,000
2001	5,000	22,497	53,060	21,611	110,000	899,891	2,653,020
2002	5,000	23,397	54,122	22,183	130,000	1,169,859	2,706,060
2003	5,000	24,333	55,204	22,774	150,000	1,459,983	2,760,202
2004	5,000	25,306	56,308	23,384	170,000	1,771,447	2,815,406
2005	5,000	26,319	57,434	24,014	190,000	2,105,491	2,871,714
2006	5,000	27,371	58,583	24,665	210,000	2,463,424	2,929,148
2007	5,000	28,466	59,755	25,337	250,000	2,846,624	2,987,731

Figure C-9

On the basis of the number of central offices that will be DSL capable, the number of subscribers in each region, and the primary demand model, the reachable demand is calculated for each subregion for each year as shown in Figure C-10.

year	Available Demand: reachable potential subscribers served by DSL capable offices: Rural	Suburban	Urban	Total
1998	585	3,439	56,146	60,170
1999	1,321	11,397	88,367	101,084
2000	2,506	26,018	129,092	157,616
2001	4,211	49,327	177,264	230,802
2002	6,461	82,895	231,049	320,405
2003	9,228	127,654	288,216	425,098
2004	12,446	183,873	346,541	542,860
2005	16,026	251,285	404,115	671,426
2006	19,870	329,279	459,510	808,659
2007	25,965	417,100	511,808	954,873

Note: Available demand is a function of demand for the service, the fraction of potential subscribers who can be reached by the technology (loop constraints) and the fraction of central offices in the subregion which have been made DSL capable

Figure C-10

The Expanded Inputs sheet also is used to enter less frequently changed data. Three of those data items are shown in Figure C-11 below. They are the cost of capital allowed by the regulators, a word (which can be either Regulatory or Economic) that controls how capital costs and depreciation are calculated, and the discount rate for consumer expenditures. If the capital analysis word is set to Economic, then the firm's hurdle rate and economic depreciation are used in calculating costs. If the capital analysis word is set to Regulatory, then the regulator's allowed cost of capital and regulatory depreciation is used in calculating the cost of service each year. The capital analysis variable cannot be used directly to set prices. Rather, if the user wishes to mimic a utility rate case, the user can set prices equal to the cost of service. This process may require iteration because the demand and market share (and hence average costs) are a function of the prices charged.

	A	B	C	D	E
83					
84	**Regulator's allowed cost of capital**				12%
85	**Capital Analysis (Economic or Regulatory):**				Regulatory
86	**Consumer discount rate**				25%
87					

Figure C-11

The prices charged by both the firm under study and the competitor are expressed on the Scenario Inputs sheet in a terse form. Those terse forms are expanded as shown in Figure C-12. As before, these numbers can be edited by the user.

The model inputs below are derived from the numbers on the scenario inputs sheet. The user can overwrite the numbers below. Be aware that the link to the input sheet figures is broken if this is done. Save the file under a new name.

Study Firm Prices	Annual Usage			Installation Charge		
year	Rural	Suburban	Urban	Rural	Suburban	Urban
1998	$525	$500	$425	$200	$200	$200
1999	$473	$450	$383	$180	$180	$180
2000	$425	$405	$344	$162	$162	$162
2001	$383	$365	$310	$146	$146	$146
2002	$344	$328	$279	$131	$131	$131
2003	$310	$295	$251	$118	$118	$118
2004	$279	$266	$226	$106	$106	$106
2005	$251	$239	$203	$96	$96	$96
2006	$226	$215	$183	$86	$86	$86
2007	$203	$194	$165	$77	$77	$77

Competitor Prices						
year	Rural	Suburban	Urban	Rural	Suburban	Urban
1998	$525	$500	$425	$200	$200	$200
1999	$473	$450	$383	$180	$180	$180
2000	$425	$405	$344	$162	$162	$162
2001	$383	$365	$310	$146	$146	$146
2002	$344	$328	$279	$131	$131	$131
2003	$310	$295	$251	$118	$118	$118
2004	$279	$266	$226	$106	$106	$106
2005	$251	$239	$203	$96	$96	$96
2006	$226	$215	$183	$86	$86	$86
2007	$203	$194	$165	$77	$77	$77

Figure C-12

The input data for the market share model are entered in on the Expanded Inputs sheet as shown in Figure C-13.

Market share model parameters		
	Fraction of comparison price to set lower comparison range	25.0%
	Fraction of comparison price to set upper comparison range	25.0%
	Number of firms to consider	2
	Subscribers who do not consider switching firms in any year (inertia factor)	70.0%

Figure C-13

f. Firm Cash Flow

This sheet displays the revenue, expenses, net capital plant, net cash flow, the weight for calculating net present value, the weighed cash flow, and the cumulative weighted cash flow for each year. It also shows the net present value for the enterprise, which is the sum of the weighted cash flows and the terminal value. The terminal value is calculated as if the last year's cash flow

were continued forever. Figure C-14 contains a sample of the Firm Cash Flow sheet. There are no user inputs on this sheet.

Cash Flow Analysis

Cash Flow and NPV Calculations

Year	Revenue	Expenses	Investment	Net Capital Plant	Net Cash Flow	NPV Weight	Weighted Cash Flow	Cumulative Weighted Cash Flow
1998	$18,961,342	$29,499,166	$19,079,960	$19,079,960	-$25,806,781	0.80	-$20,645,425	-$20,645,425
1999	$23,458,792	$16,675,279	$10,051,018	$27,609,569	$2,225,700	0.64	$1,424,448	-$19,220,977
2000	$32,600,431	$21,783,775	$12,959,404	$38,368,916	$5,475,966	0.51	$2,803,695	-$16,417,282
2001	$42,591,259	$26,879,335	$15,749,120	$51,125,991	$10,093,142	0.41	$4,134,151	-$12,283,131
2002	$52,801,524	$31,697,749	$18,141,468	$65,272,239	$15,882,628	0.33	$5,204,420	-$7,078,711
2003	$62,622,060	$35,967,407	$19,945,432	$80,130,020	$22,560,690	0.26	$5,914,149	-$1,164,562
2004	$71,559,383	$43,052,963	$21,083,891	$94,976,046	$26,204,374	0.21	$5,495,455	$4,330,893
2005	$79,282,034	$49,987,813	$21,581,346	$109,174,911	$29,298,055	0.17	$4,915,398	$9,246,291
2006	$85,621,975	$56,550,201	$21,529,181	$122,219,902	$31,705,461	0.13	$4,255,435	$13,501,726
2007	$90,838,973	$62,973,713	$21,585,928	$134,309,350	$32,835,469	0.11	$3,525,682	$17,027,408

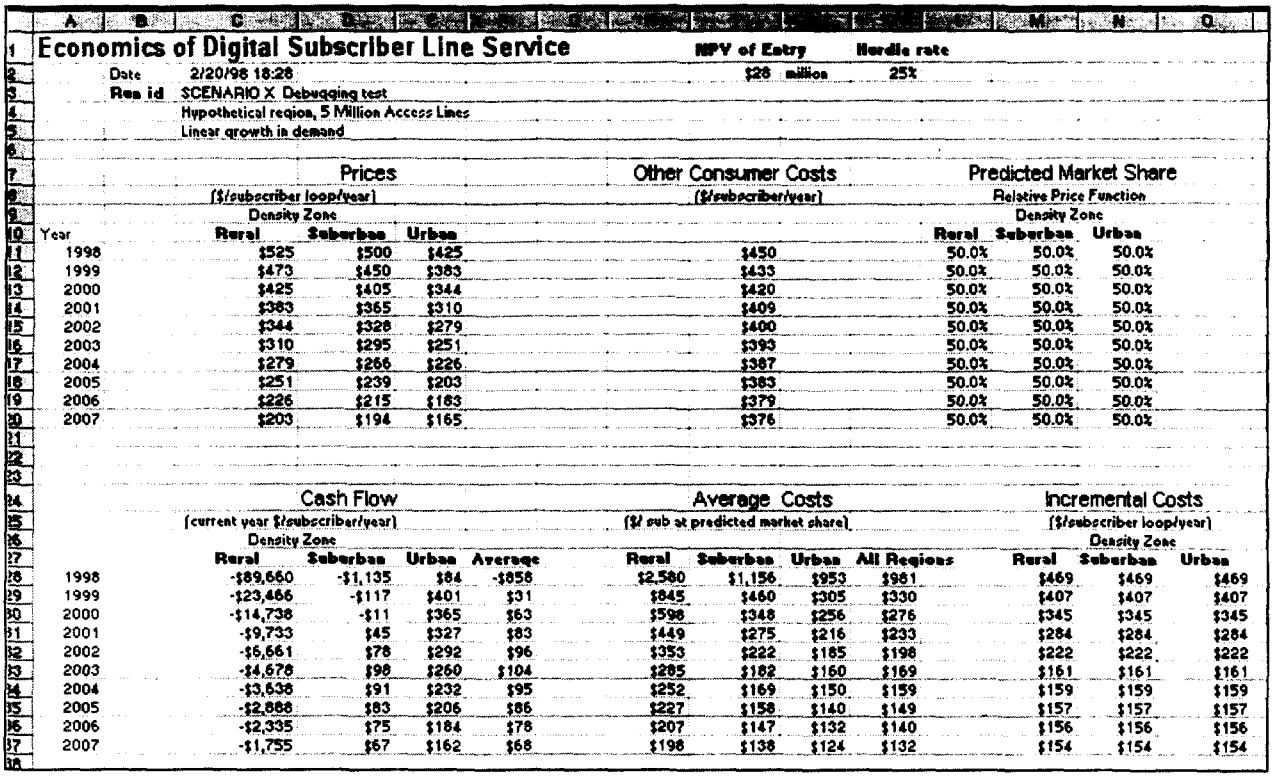
Terminal value	$10,577,045
NPV	$27,604,453

We use the NPV of an infinite stream (starting in year 11) of year 10's cash flow as the terminal value.

Figure C-14

g. xDSL Subscriber Economics

This sheet displays some outputs normalized on a per subscriber basis. An example of that sheet is shown in Figure C-15.



Economics of Digital Subscriber Line Service

		NPV of Entry	Hurdle rate
Date	2/20/96 16:26	$28 million	25%
Run id	SCENARIO X Debugging test		
	Hypothetical region, 5 Million Access Lines		
	Linear growth in demand		

	Prices ($/subscriber loop/year)			Other Consumer Costs ($/subscriber/year)	Predicted Market Share Relative Price Function		
	Density Zone				Density Zone		
Year	Rural	Suburban	Urban		Rural	Suburban	Urban
1998	$525	$500	$425	$450	50.0%	50.0%	50.0%
1999	$473	$450	$383	$433	50.0%	50.0%	50.0%
2000	$425	$405	$344	$420	50.0%	50.0%	50.0%
2001	$383	$365	$310	$409	50.0%	50.0%	50.0%
2002	$344	$328	$279	$400	50.0%	50.0%	50.0%
2003	$310	$295	$251	$393	50.0%	50.0%	50.0%
2004	$279	$266	$226	$387	50.0%	50.0%	50.0%
2005	$251	$239	$203	$383	50.0%	50.0%	50.0%
2006	$226	$215	$183	$379	50.0%	50.0%	50.0%
2007	$203	$194	$165	$376	50.0%	50.0%	50.0%

	Cash Flow (current year $/subscriber/year)				Average Costs ($/ sub at predicted market share)				Incremental Costs ($/subscriber loop/year)		
	Density Zone								Density Zone		
	Rural	Suburban	Urban	Average	Rural	Suburban	Urban	All Regions	Rural	Suburban	Urban
1998	-$89,660	-$1,135	$84	-$858	$2,580	$1,156	$953	$961	$469	$469	$469
1999	-$23,466	-$117	$401	$31	$845	$460	$305	$330	$407	$407	$407
2000	-$14,738	-$11	$365	$63	$598	$348	$256	$276	$345	$345	$345
2001	-$9,733	$45	$327	$83	$449	$275	$216	$233	$284	$284	$284
2002	-$6,661	$78	$292	$96	$353	$222	$185	$198	$222	$222	$222
2003	-$4,678	$98	$260	$104	$285	$182	$160	$169	$161	$161	$161
2004	-$3,636	$91	$232	$95	$252	$169	$150	$159	$159	$159	$159
2005	-$2,868	$83	$206	$86	$227	$158	$140	$149	$157	$157	$157
2006	-$2,335	$75	$184	$78	$207	$147	$132	$140	$156	$156	$156
2007	-$1,755	$67	$162	$68	$198	$138	$124	$132	$154	$154	$154

Figure C-15

h. Subscriber Economics Graphs

This sheet displays the same information as does the preceding sheet, but in graphical format. An example of this output is shown below in Figure C-16.

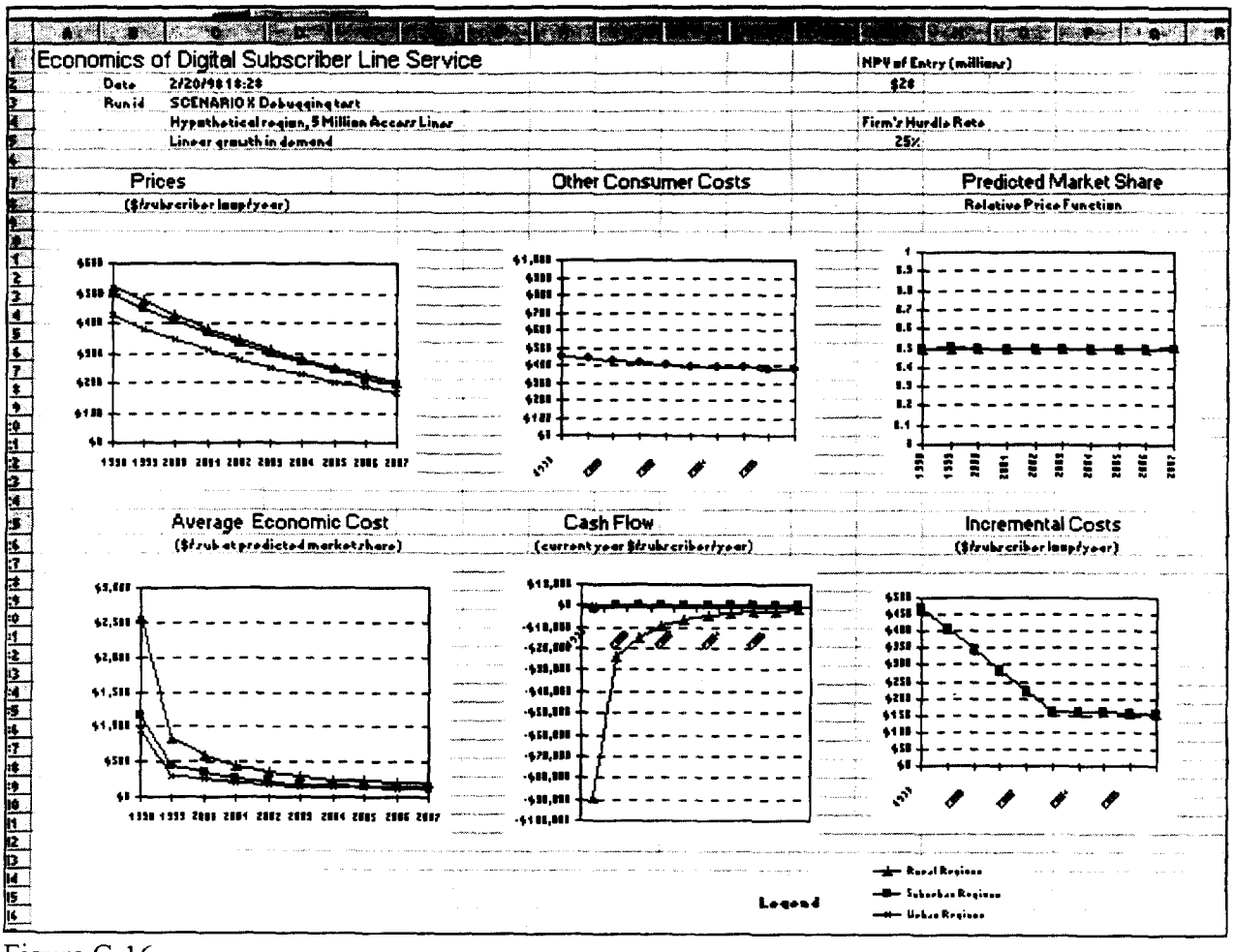
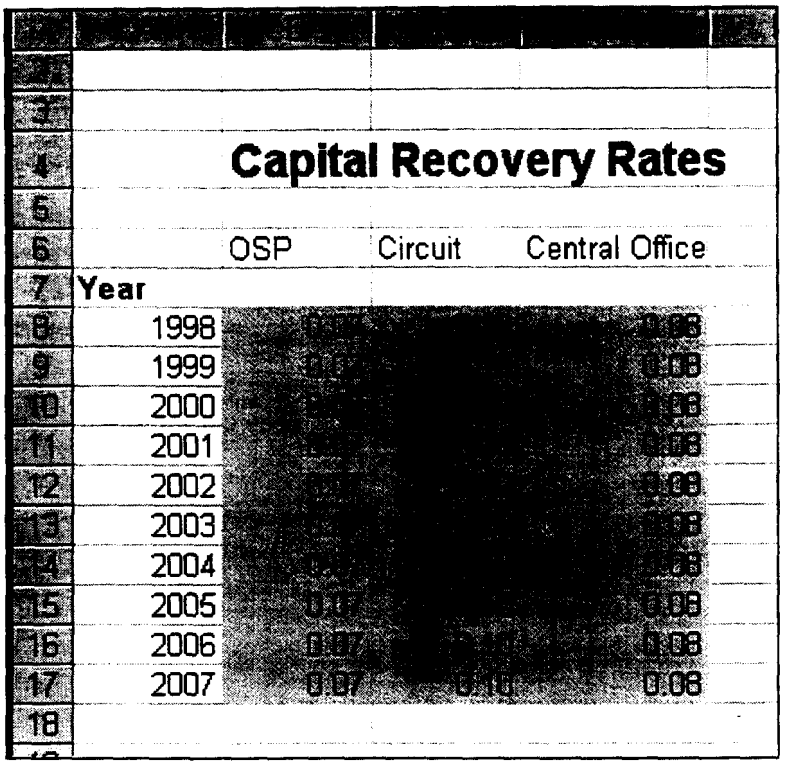


Figure C-16

i. Regulatory Factors

This sheet contains regulatory depreciation rates for outside plant, circuit equipment, and central office equipment. A sample of this sheet is shown in Figure C-17. These data can be modified by the user.



	Capital Recovery Rates		
	OSP	Circuit	Central Office
Year			
1998			
1999			
2000			
2001			
2002			
2003			
2004			
2005			
2006			
2007			

Figure C-17

j. Administrative Support Costs

This sheet contains a specification of the annual administrative costs associated with four activities – maintaining an existing customer, attracting and maintaining a new customer, starting activities in the entire region, and beginning xDSL service in a single central office. An example of this sheet is shown in Figure C-18. All the numbers on this sheet can be varied by the user.

The example in Figure C-18 illustrates a substantial disparity between the first-year costs of supporting a customer and the costs in subsequent years. The rationale for such a disparity is that consumers will require more support in the first year than in later years and that marketing costs are assigned to the year the consumer signs up.

	A	B	C	D	E	F	G
1	**Administrative, Sales, and Support Expenses**						
2	Note: This cost category is intended to reflect those costs directly associated with						
3	provision of digital subscriber services. It is not intended to reflect general overhead.						
4							
5	These also reflect costs which are normally expensed (e.g., training, software development) even though they tend to be front loade						
6							
7	**Year**						
8		Administrative, Sales, and Support expenses per existing customer	Administrative, Sales, and Support expenses per net customer added	Administrative and Support expenses for region startup	Administrative and Support expenses for CO or Remote startup		
9	1998	$50	$400	$10,000,000	$30,000		
10	1999	$50	$340	$10,000,000	$30,000		
11	2000	$50	$280	$10,000,000	$30,000		
12	2001	$47	$220	$10,000,000	$30,000		
13	2002	$44	$160	$10,000,000	$30,000		
14	2003	$41	$100	$10,000,000	$30,000		
15	2004	$38	$100	$10,000,000	$30,000		
16	2005	$35	$100	$10,000,000	$30,000		
17	2006	$32	$100	$10,000,000	$30,000		
18	2007	$29	$100	$10,000,000	$30,000		

Figure C-18

k. Capital Cost Factors

This sheet contains the capital cost, the associated annual recurring costs, and the economic depreciation rate associated with each type of capital investment for each year. It also displays (for error-checking purposes) the regulatory depreciation rate associated with this class of investment and the depreciation rate actually used in the cost analysis. Figure C-19 displays part of the Capital Cost Factors sheet.

DSL Cost Factors

This category is intended to reflect the cost of capital equipment, plant and other investments needed by the service provider. Thus, if consumer modems and inside wiring are owned and paid for by the user, the corresponding entries on this page should be zero.

		Capital	Annual Recurring Costs Associated	Depreciation Rate Used in Analysis	Economic Depreciation Rate for Capital Investment	Regulatory Depreciation Rate for Capital Investment
Customer Premises						
Modem, other equipment	Year					
	1998	$0	$0	10%	25%	10%
	1999	$0	$0	10%	25%	10%
	2000	$0	$0	10%	25%	10%
	2001	$0	$0	10%	25%	10%
	2002	$0	$0	10%	25%	10%

Figure C-19

l. Revenues and Expenditures

This sheet contains the calculation of all the capital expenditures, expense items, and revenue for each of the ten years. It is the most complex of the sheets.

i. Cost Calculations

The model considers costs as arising from four different LEC activities:[36]

-the firm provision of DSL services

(e.g., training, development of billing systems)

-equipping a specific central office

(e.g., DSLAMs, training, OAM, network connectivity)

-Subscriber-specific outlays

(e.g., DSL modem, administrative costs, installation of the splitter and NCTE, costs for any CPE provide by the network service provider)

-Complementary expenditures by consumers

(e.g., DSL modem, inside wiring, computers, ISP services).

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[36] The model is not limited to analysis of LEC DSL services. With data modifications it would also provide an analysis of the economics of cable modem deployment.

Costs can be either capital investment or expense items. Specification of capital investment items requires specification of associated operating costs.

ii. Investment

The model considers several categories of investment and in most categories permits costs to be generated based upon several activities. Categories and activities generating costs are shown in the table below.

Investment Category	Activities that generate investments in this category
Subscriber Premises	modem inside wiring
Outside Plant	capability in region per central office per subscriber urban suburban rural
Central Office	for DSL capability per subscriber (no variation with location)
Backhaul (digital connectivity)	capability in region per central office per subscriber
OA&M	capability in region per central office per subscriber

A few points must be noted here. The model also provides for a calculation of the complementary expenditures by consumers (e.g., ISP costs, home computer). Naturally, if the consumer is expected to purchase the DSL modem and provide for inside wiring, then these elements should not also be listed as costs for the service provider. (We assume that the subscriber amortizes these